'VI-like' and 'aVF-like' leads for continuous electrocardiographic monitoring

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A standardized method for continuous electrocardiographic monitoring is presented. Tracings similar to VI and aVF leads of the conventional electrocardiogram can be recorded, and switching from one lead to the other does not require changes in the chest electrode positions. Easy reproduction of day-to-day tracings is an advantage of the method.

An increasing number of patients is being monitored in Coronary Care Units; however, there have been few attempts to standardize monitoring techniques (Marriott and Fogg, 1968, 1970; Marriott and Thorne, 1971). In most units, the monitoring leads are placed arbitrarily to monitor clear P and QRS complexes. Electrode positioning varies from unit to unit, from patient to patient, and even from day to day in the same patient, thus making comparison of recorded tracings factitious. The resultant lead has been sarcastically labelled 'BBL' (bastard bipolar lead) (Marriott and Fogg, 1970).

In order to improve monitoring techniques, a lead system based on that of Marriott and Fogg (1970) was introduced into our unit at the Negev Central Hospital, Beer Sheva, Israel.

Method

The three electrodes supplied with the monitoring system were placed as follows. (1) At the usual VI position - over the 4th intercostal space at the right sternal border; (2) near the left shoulder, under the outer third of the left clavicle; and (3) at the left anterior axillary line over the 9-10th intercostal space.

When electrode 1 is connected to the positive pole, electrode 2 to the negative pole, and electrode 3 to the ground wire (Fig. 1A), a tracing is recorded similar to the conventional VI lead, and is referred to here as 'VI-like' monitor lead. If electrode 1 is connected to the ground wire and electrode 3 to the positive pole, while electrode 2 remains connected to the negative pole, the tracing obtained, similar to the conventional aVF lead, is referred to as 'aVF-like' monitor lead (Fig. 1B).

Reversing electrode polarity permits 'VI-like'

and 'aVF-like' leads to be interchangeable, without altering the position of the chest electrodes. This change in the polarity is achieved either by reversing the connexion between the chest electrodes of patient cable, or by operating a lead selector switch.

FIG. 1 Position and polarity of the three chest electrodes.

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In all, 250 patients admitted to the Coronary Care Unit at the Negev Central Hospital since March 1971 were monitored according to the above method. Our results provide an excellent correlation, in about two-thirds of the cases, between the monitoring leads and the aVF and/or VI lead of the conventional 12-lead electrocardiogram. In the rest of the cases, the correlation was acceptable, in that the direction of the QRS and P main vector was the same in the two types of leads.

Illustrative tracings were recorded by means of a Sanborn 7712 recorder equipped with 2 electrocardiograph preamplifiers (350–3200 A). One preamplifier was connected to the monitoring system and the second to a conventional 12 lead electrocardiogram, and simultaneous strips were recorded (Fig. 2 and 3).

Discussion

Both theoretically and practically an acceptable method for continuous electrocardiographic monitoring should fulfil three requirements. (1) The bipolar chest lead principle, which forms the basis of the majority of the monitoring equipment in current use. (2) Placement of the electrodes should avoid discomfort and permit access to the left chest for examination. (3) To provide reliable and reproducible information on the elements necessary for electrocardiographic diagnosis.

For monitoring purposes, these elements are, principally: (a) differentiation between right and left bundle-branch block patterns (ventricular versus supraventricular ectopy with aberrant conduction; left versus right ventricular impulse formation); (b) recognition of sudden changes in the direction of the main frontal vector of the QRS complex (shifting to the left in left anterior hemiblock or to the right in left posterior hemiblock); and (c) recognition of changes of polarity of the P wave (junctional rhythms).

The possibility of monitoring patients with leads similar to VI or aVF is attractive, since it allows not only differentiation between right and left bundle-branch block during arrhythmia, but also changes in the form and direction of the QRS vector during a stable rhythm, which might herald the development of complete AV block.

The method permits the easy reproduction of the tracings, even after daily changing of chest electrodes. Small adjustments of electrode position enable recording of comparable tracings which closely resemble the conventional lead pattern in the electrocardiogram of the same day.

The main difference between our method and that reported by Marriott and Fogg (1970) is the positioning of the ground electrodes at the left lower chest at the time the 'VI-like'

FIG. 2 Simultaneous recording of monitor and conventional leads (upper tracing: 'aVF-like' monitor lead and aVF. Lower tracing 'VI-like' monitor lead and VI). (A) Right bundle-branch block and left anterior hemiblock during sinus rhythm. (B) Premature ventricular beat, arising in the left ventricle, probably in its anterior wall. (C) Atrial premature beat (upper tracing), 'P mitrale', identifiable at VI-like and VI (lower tracing). (D) Supraventricular premature beat with aberrant conduction through the right bundle and the anterior division of the left bundle.

FIG. 3 Simultaneous recording of monitor and conventional leads (upper tracing 'aVF-like' monitor lead and aVF. Lower tracing 'VI-like' monitor lead and VI). Atrial fibrillation and complete AV block. An endocardial pacemaker positioned at the right ventricle activates the ventricle in the three last beats of each strip.

lead is recorded, so that switching to 'aVF-like' lead requires only polarity changes while the chest electrodes remain in their original position.

We suggest that, in order that less experienced personnel will be able to understand better the significance of these tracings and to interpret better the changes that might appear during monitoring, these leads should be referred to as 'V₁-like' and 'aVF-like' rather than 'MCL₁' and M₃, suggested by Marriott and Fogg (1970).

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